true state of the case. The rainfall that has been withheld from the United States represents but an utterly insignificant fraction of the total quantity of moisture in the atmosphere, and its retention in the air can have but little effect on the phenomena that may have occurred elsewhere. If, as is most probable, the moisture is fairly well distributed throughout the atmosphere, it will not be practicable with our present knowledge to ascertain where that which is withheld from us should descend as rain. In fact, the collection of data relative to weather in distant regions, so far as we have at present progressed, suggests the possibility that droughts have occurred this year in almost all regions from which we have meteorological reports, whence we may conclude that the atmosphere is, on the average, slightly drier than usual, possibly the tenth or the hundredth part of 1 per cent, a conclusion to which, in fact, we were lead by a study of the winds in some editorial remarks on page 337 of the September REVIEW. This conclusion is, in fact, the very opposite of that suggested by our correspondent, whose words imply that there must on the average be the same amount of rainfall annually all over the globe, as a whole, and that, therefore, a diminished rainfall over the United States, together with increased evaporation, necessarily means that the atmosphere has, temporarily, a larger charge of moisture than usual.

If we accept as a working hypothesis the idea that the whole atmosphere can have appreciably less moisture one year than another, we are led then to inquire as to the reason for this. Several reasons may be suggested as equally plausible. The first is purely mechanical, and rests upon the conclusion, which now amounts almost to a demonstration, that the average condition of the atmosphere as a whole may vary from year to year in an irregular way precisely as the annual average condition is known to vary for any given station, and even for large sections of the country. We have no right to assume that the average temperature or moisture, or movement, or pressure of the atmosphere of the whole globe will be the same from year to year any more than that the local station averages will be the same. This is equivalent to recognizing the fact that the atmospheric phenomena do not and can not go through short cycles only, but must necessarily also go through many long cycles, and that none of these are necessarily recurrent. In technical terms we should say that atmospheric phenomena are not a case of steady motion.

A second hypothesis that may be plausibly suggested is that the cause of these irregularities lies outside of the earth, and may be due to the irregularities in the quantities of heat sent to us from the sun from year to year. It has been plausibly argued from the observations of temperature that there is a periodicity in the solar radiation parallel to that of the sun spots, so that the whole atmosphere receives more heat, and consequently must have a little more moisture, and perhaps yield more rains and storms when the sun spots are most numerous. But this hypothesis does not seem to be needed at present.

THE EXTENT OF A LOCAL RAIN.

In continuation of our remarks in the September REVIEW as to the limiting area of what may be called a local storm we append the following table showing the details of the rainfall at Jupiter, Fla., and at Hypoluxo, which is 33 miles south of that station and about the same distance from the seashore. At Jupiter the coast line trends north-northwest and south-southeast, but at Hypoluxo the trend is more nearly north and south. The maximum monthly rainfalls usually occur on this coast in either August or September, but for the present year they have occurred in October, and have been heavier at Jupiter and Hypoluxo than any other region. The following table gives the rainfall, measured daily at 8 a. m. and 8 p. m. at Jupiter, and in the next columns the total rain at each station for the twenty-four hours preceding 8 a. m. of the respective dates. These falls were usually heavier during the twelve hours, 8 p. m. to 8 a. m., than during the daytime; they were almost invariably accompanied by north, east, or northeast winds attending cyclonic disturbances to the eastward. The differences in the 24-hour rainfall up to 8 a. m. of each day, as given in the last columns of this table, show how very local the heavy rainfalls must have been, and how many stations are necessary for the proper presentation of the distribution of heavy rainfall over any country, even a flat and uniform land, like Florida:

Daily Rainfall, October, 1895.

Date.	Jupiter.		8 p.m. + 8 a. m. daily.		Date.	Jupiter.		8 p.m. + 8 a. m. daily.	
	8 a.m.	8 p.m.	Jupiter.	Hypoluxo.		8 a.m.	8 p.m.	Jupiter.	Hypoluxo.
September 30.	....	0.10	....	....	October 17....	0.54	0.08	0.69	0.99
October 1....	0.10	1.72	0.20	0.72	18....	2.97	1.37	3.00	1.00
2....	T.	T.	1.72	0.12	19....	0.48	0.00	1.85	0.94
3....	0.08	0.06	0.08	0.00	20....	0.01	1.84	0.01	3.45
4....	0.02	0.00	0.08	0.00	21....	2.00	0.90	3.84	4.05
5....	0.00	0.00	0.00	0.00	22....	2.30	0.06	3.20	0.00
6....	0.00	0.00	0.00	0.00	23....	0.00	0.00	0.06	0.00
7....	0.00	0.00	0.00	0.00	24....	0.00	0.00	0.00	0.00
8....	0.00	0.00	0.00	0.00	25....	0.00	0.00	0.00	0.00
9...	0.00	0.21	0.00	1.15	26....	0.00	0.00	0.00	0.00
10....	1.84	0.18	2.05	0.04	27....	0.00	0.00	0.00	0.00
11....	0.00	0.00	0.18	0.00	28....	0.00	T.	0.00	7.50
12....	0.18	0.16	0.18	0.33	29....	T.	0.87	T.	1.33
13....	T.	T.	0.16	0.00	30....	0.03	0.01	0.90	0.00
14 ...	0.00	0.00	0.00	0.00	31....	0.00	0.00	0.01	0.00
15....	1.52	0.82	1.52	1.74					
16....	0.58	0.15	1.40	1.03		12.65	8.38	21.13	24.39

OBSERVATIONS AT HONOLULU.

Meteorological observations at Honolulu, Republic of Hawaii, by Curtis J. Lyons, Meteorologist to the Government Survey.

Pressure is corrected for temperature and reduced to sea level, but the gravity correction, —0.06, is still to be applied.

The absolute humidity is expressed in grains of water, per cubic foot, and is the average of four observations daily.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 10.

The rainfall for twenty-four hours is given as measured at 6 a. m. on the respective dates.

August, 1895.	Pressure at sea level.			Temperature.					Humidity.			Wind.		Cloudiness.	Rain measured at 6 a. m.
	9 a. m.	3 p. m.	9 p. m.	6 a. m.	2 p. m.	9 p. m.	Maximum.	Minimum.	Relative. 9 a. m.	Relative. 9 p. m.	Absolute.	Direction.	Force.		
	Ins.	*Ins.*	*Ins.*	°	°	°	°	°	%	%					*Ins.*
1..	30.00	29.94	29.98	77	82	78	86	77	71	74	7.6	ne.	5–3	8	0.07
2..	29.99	29.94	29.97	78	78	78	78	76	80	79	8.4	ene.	6	10	0.06
3..	30.00	29.95	30.00	78	80	77	81	77	79	77	8.0	ne.	4	10	0.65
4..	30.02	29.95	30.01	77	81	77	84	77	69	70	7.0	ne.	4	8	0.01
5..	30.02	29.97	30.02	76	81	77	84	76	66	71	6.9	ne.	3	3	0.00
6..	30.02	29.97	30.07	75	82	77	85	72	64	74	7.1	ne.	4	3	0.05
7..	30.07	30.00	30.06	76	83	75	85	75	67	80	7.4	ne.	4	3	0.03
8..	30.04	29.97	30.03	76	81	77	82	76	69	70	7.4	ne.	3	4	0.06
9..	30.04	29.98	30.06	75	83	77	85	75	64	70	7.2	ne.	4	4	0.03
10..	30.06	29.99	30.05	74	83	73	86	70	64	74	6.9	ne.	4	4	0.00
11..	30.03	29.96	30.02	75	84	74	85	71	71	74	7.3	ne.	3–0	3	0.00
12..	30.03	29.97	30.00	71	74	76	85	69	67	74	7.2	w-s-e.	1	9–3	0.00
13..	30.02	29.93	29.99	76	82	77	84	74	64	65	6.9	ne.	4	3	0.09
14..	30.00	29.93	30.01	74	82	77	84	72	70	70	6.8	ne.	3	4	0.02
15..	30.00	29.94	30.00	74	82	76	84	72	75	78	7.5	ene.	4	4	0.13
16..	30.04	29.99	30.08	74	82	77	84	74	82	70	7.5	ene.	5	8	0.17
17..	30.09	30.04	30.10	76	82	75	84	76	64	80	7.0	ne.	3	4	0.04
18..	30.11	30.05	30.10	76	80	76	82	73	79	76	7.4	ne.	3	9	0.19
19..	30.10	30.04	30.08	74	79	76	82	73	67	67	6.9	ne.	5	4	0.30
20..	30.10	30.03	30.08	72	75	75	79	71	80	77	7.4	ene.	4	10–7	0.10
21..	30.06	30.00	30.06	74	79	76	82	73	72	74	7.2	ne.	3	5	0.15
22..	30.06	29.99	30.05	72	82	78	84	72	72	75	8.0	ene.	3	5	0.06
23..	30.06	30.00	30.06	72	82	77	85	71	65	74	7.5	ene.	3	4	0.13
24..	30.05	29.97	30.04	75	81	75	84	74	70	77	7.6	nne.	0–4	2	0.01
25..	30.04	29.98	30.04	70	82	76	85	69	69	75	7.7	s-ne.	1–3	2–5	0.11
26..	30.02	29.95	30.02	75	84	75	85	72	65	85	7.5	se-ne.	2	3	0.00
27..	30.01	29.95	30.01	70	83	75	83	70	80	80	8.0	sw-ne.	2	4	0.35
28..	30.02	29.94	30.02	75	84	78	86	71	68	75	7.8	e.	3	4–0	0.06
29..	30.03	29.96	30.04	78	83	78	85	77	68	69	7.4	ene.	3	3	0.00
30..	30.01	29.97	30.04	78	82	77	84	77	68	67	7.1	ne.	3	3	0.00
31..	30.04	29.98	30.04	76	81	78	83	75	65	65	6.7	ne.	4	4	0.00
	30.04	29.97	30.03	74.8	81.2	76.4	83.7	73.4	69.8	74.0	7.6	....	3.3	4.8	2.87

The monthly summary for August is: Mean temperature, 77.5; the normal is 77.8; extreme temperatures, 86 and 69. Two directions of wind, *connected by a dash*, indicate change from one to the other; also same for force.

Meteorological observations at Honolulu, Republic of Hawaii, by Curtis J. Lyons, Meteorologist to the Government Survey.

September, 1895.	Pressure at sea level.			Temperature.					Humidty.			Wind.		Cloudiness.	Rain measured at 6 a. m.
									Relative.		Absolute.				
	9 a. m.	3 p. m.	9 p. m.	6 a. m.	2 p. m.	9 p. m.	Maximum.	Minimum.	9 a. m.	9 p. m.		Direction.	Force.		
	Ins.	Ins.	Ins.	°	°	°	°	°	%	%					Ins.
1 ..	30.06	30.00	30.06	76	82	76	84	73	61	74	6.7	ne.	3	3-6	0.04
2 ..	30.05	29.98	30.04	76	81	77	84	74	61	70	7.0	e-ne.	4	4	0.06
3 ..	30.02	29.95	29.98	74	81	76	82	73	72	74	7.8	ne.	3	7	0.13
4 ..	29.99	29.92	29.98	74	81	79	85	73	75	82	8.6	e-ne.	4	5-10	0.08
5 ..	30.04	29.96	30.05	76	81	72	85	75	82	91	8.7	s-n.	1-4-0	10	0.81
6 ..	30.01	29.96	30.01	75	81	77	83	70	67	70	7.1	ne.	4	3-6	1.03
7 ..	30.00	29.95	29.98	73	76	77	79	72	77	70	7.4	ne.	3	6	0.33
8 ..	29.98	29.92	29.98	76	80	77	81	71	68	74	7.4	ne.	6	4	0.41
9 ..	30.06	30.00	30.07	76	82	78	83	75	69	75	7.4	ne.	5	6	0.06
10 ..	30.07	30.00	30.06	74	81	77	82	73	68	72	7.4	ne.	4	5	0.06
11 ..	30.01	29.94	30.02	76	82	76	83	75	60	76	7.1	ne.	4	4	0.02
12 ..	29.99	29.94	30.00	76	81	77	81	73	75	74	7.5	e-ne.	4	5	0.02
13 ..	30.01	29.96	30.04	75	81	75	82	72	72	68	7.2	e-ne.	5	5	0.08
14 ..	30.05	29.98	30.03	74	81	78	83	73	71	69	7.2	ne.	3	3	0.13
15 ..	30.06	29.97	30.05	76	81	78	83	74	68	71	7.2	ne.	3-5	3	0.09
16 ..	30.05	29.98	30.07	75	83	79	84	73	71	71	7.5	ne.	3	2	0.07
17 ..	30.11	30.02	30.08	77	82	78	83	74	68	70	7.4	n-ne.	4	3	0.05
18 ..	30.09	30.03	30.08	77	81	78	82	75	70	68	7.1	ne.	3	8	0.00
19 ..	30.08	29.99	30.07	76	82	77	83	74	64	68	6.9	ne.	4	8	0.11
20 ..	30.06	30.00	30.07	74	80	77	82	71	68	68	7.0	ne.	5	5	0.30
21 ..	30.10	30.01	30.09	75	80	78	82	75	64	68	7.0	ne.	4	3	0.07
22 ..	30.08	30.02	30.10	74	80	77	81	72	68	71	7.1	ne.	5	4	0.32
23 ..	30.08	29.99	30.07	74	80	75	81	72	68	77	7.1	ne.	4	4	0.06
24 ..	30.08	29.97	30.04	74	79	76	81	72	71	74	7.1	ne.	4	4	0.23
25 ..	30.03	29.96	30.03	74	81	77	83	72	68	71	7.2	ne.	3	5	0.07
26 ..	30.03	29.96	30.06	73	79	74	81	70	77	77	7.4	ne.	2	10	0.01
27 ..	30.05	29.96	30.06	69	81	76	82	67	79	74	7.4	ne.	1-3	10-2	0.01
28 ..	30.08	29.98	30.08	71	80	73	81	67	73	77	7.2	n-ne.	2-0	8-2	0.03
29 ..	30.09	29.99	30.07	73	80	76	83	70	68	64	6.6	n-ne.	2	1	0.16
30 ..	30.05	29.95	29.99	72	79	76	81	72	68	70	6.9	n-ne.	3	4	0.00
	30.05	29.98	30.04	74.5	80.6	76.6	82.8	72.4	69.7	72.6	7.3	ne.	3.5	4.7	4.34

Mean temperature: 6+2+9+3 is 77.2; the normal is 77.4; extreme temperatures, 85° and 67°. Two directions of wind, connected by a dash, indicate change from one to the other; also same for force.

LIGHTNING FLASHES BY PAIRS.

In regard to the electric storm of September 17 at Montpellier, Ohio, the observer, Mr. Waterston, states that—

One of the strange features of the lightning was that many of the bolts appeared to descend in pairs, about 10 feet apart. * * * I examined a tree that was struck by lightning, and it looked as though three bolts had come down it. * * * Parties living near by say that one of those double bolts was plainly seen coming down in the direction where the tree stood. Other persons report that where bolts came down and struck the ground several good-sized holes were made.

[NOTE.—It is not uncommon for a lightning flash to divide into several parts as it nears the ground, but these will hardly be called double or triple bolts. It is, however, rare to find the exact spot where a bolt has struck the ground, and if a hole is identified as certainly caused by the lightning, then it will always be interesting to dig down and recover, at least, a fragment of the long fulgurite, or tube, that is apt to be formed by the melting together of the grains of soil by the lightning as it passes downward.]

THE NOR'WESTERS OF CANTERBURY.

In the New Zealand Alpine Journal, Vol. II., No. 8, the editor, Mr. J. T. Meeson, has a paper on the hot, dry winds that blow from the northwest across the mountains and over the eastern plains of both islands, and are felt in their greatest intensity in the Province of Canterbury, in the South Island. The following abstract is from the Bulletin of the American Geographical Society, Vol. XXVII, p. 409:

These winds are most frequent in the late spring and summer, from October to March, with their greatest strength perhaps in February at the time of the wheat harvest. The "nor'wester" comes on as follows: The wind blows for two or three days from the northeast and then dies away, or veers to the north; light, cirrus clouds drift in the upper sky from the northwest; the barometer falls, sometimes very fast, and the thermometer rises. A few hours of delicious weather succeed, and then, within twenty-four hours or less, comes the northwest wind, gentle at first, and even cool, with an occasional warm puff. A beautiful arch of cumulus clouds stretches across the heavens from the north to the west or southwest, and below it the sky is of a peculiar, soft blue. The arch sometimes remains through the storm, sometimes it is dissipated in a few hours. The force of wind increases to a gale, with clouds of dust and a stifling heat. Vegetation droops and withers, and human beings suffer with lassitude, headache, and neuralgia. The mountains to the west are covered with black clouds—*the true fœhn wall*—and heavy rain falls there.

This state of things lasts sometimes for days, sometimes for a few hours, when the wind veers to the west, the barometer rises, the thermometer falls, and a cold southwest wind sets in for a time, and often the process begins again. Mr. Meeson regards this hot wind as a true *fœhn*, and he accounts for it in this way: The northwest wind, charged with moisture, strikes the west coast at a temperature of 60° F. By the time it reaches the tops of the mountains, at 9,000 feet, it loses 30° of heat, while in descending the eastern side of the mountains it gains 50°, and reaches the Canterbury plains as a dry wind, with a temperature of 80° F. To this temperature is added the heat always developed in front of a cyclone.

The "nor'wester" is, on the whole, a beneficial agent. Some persons hold that it is essential to the maturity of the wheat crop; it kills or blows away the germs of disease, purifies the atmosphere, melts the snows, and plays a great part in the development of animal and vegetable life.

THE MOVEMENT OF THUNDERSTORMS AGAINST THE WIND.

The following contribution to this subject is sent by Mr. Fred. W. Rausch, now living at Topeka, Kans., in a letter dated January 20, 1896:

In regard to the phenomenon reported by Mr. E. D. Hicks in the April REVIEW, page 131, I would say that I have often observed the same in western Missouri, eastern and south central Kansas, but more so during my eight years' residence in eastern Colorado. In Colorado thunderclouds would almost always move in a southeast direction [i. e., from northwest to southeast.—C. A.]. As nearly all our rain during summer in southeast Colorado fell from thunderclouds, I gave the same particular attention. The clouds would form apparently above the mountains during the day, and in the evening break away to the southeast. If the wind was strong from the east or southeast the same would form in a solid black bank; otherwise, float off apart; in either case with more or less rain. The longer the wind would hold out against the cloud the heavier the rain. If the wind changed in the northwest in advance of the cloud, we received mostly wind. When the clouds came from the southwest against the wind, we seldom received rain in paying quantities; the same would appear to roll over one another, and where accompanied by a gale of wind the rain would do more harm than good, causing the dust to settle on the side exposed to the rain and to form a coat of mud. We called these dry rains. Side views of the falling rains traveling against the wind would show a front like this, and sometimes [The sketches are omitted; they simply show the curved streaks of falling rain stretching from the rain cloud to the ground, the convex side of the streak being on the side toward which the wind is blowing and the cloud moving. Sometimes such streaks have a double curvature, indicating two or more layers of wind from different directions.—C. A.], the wind seeming to be the strongest at the curve of the rain streak. Such rains would never last long, but were quite heavy. After the clouds were over [passed overhead] the wind would for a time return to the southeast and often blow the rain back when it was clear overhead; in fact, the wind would spread from the cloud in all directions, but always traveling with the cloud as the same passed over.

On the same subject Mr. W. D. Bruner, Weather Bureau Observer at Mobile, Ala., under date of January 21, 1896, writes:

In reference to the interesting "Notes by the Editor" in the April and August (1895) numbers of the MONTHLY WEATHER REVIEW, under the heading "Do thunderstorms advance against the wind?" I wish to offer the following remarks, which will, perhaps, serve as an explanation. Having led a pastoral life on the western plains I have frequently remarked the phenomena mentioned.

The thunderstorms of the western plains are, perhaps, not unlike those of any other part of the country, but the topography of the country, absence of trees, etc., facilitate the wide range of observation. These storms usually move from a westerly direction, dissipating in their easterly movement, and for short periods are noted for violence and energy. They have a limited rainfall area which is confined to the path of the storm. The storms are generally preceded by a stratum of high cirrus clouds, followed by dark stratus and nimbus clouds, boiling and seething with the conflicting air currents, often presenting a picture of grandeur seldom equaled. As the storm nears the point of observation the wind freshens toward the storm, but a calm prevails for a short period as the nimbus cloud approaches.